Blockstack

Stacks Token Economics Whitepaper v 2.0

October 2019

By Blockstack PBC

This paper assumes familiarity with the latest technical design of Blockstack. Readers should first read the Blockstack technical whitepaper version 2.0:

- M. Ali, J. Nelson, A. Blankstein, R. Shea, and M. J. Freedman,
  "The Blockstack Decentralized Computing Network",
  Technical Whitepaper Version 2.0, May 2019.
  https://blockstack.org/whitepaper.pdf

This paper updates the previous (2017) Stacks token economics model. Readers should use this paper (v2.0 or later) for the latest Stacks token supply model.

DISCLAIMER: The Blockstack Tokens, "Stacks tokens" or "Stacks" are a crypto asset that is currently being developed by Blockstack PBC and its affiliates. The website for Stacks tokens can be found at www.stackstoken.com.

The Securities and Exchange Commission (SEC) has qualified the offering statement that we have filed with the SEC under Regulation A for our offering of certain of our Stacks Tokens. The information in that offering statement is more complete than the information we are providing now, and could differ in important ways. You must read the documents filed with the SEC before investing. The offering is being made only by means of its offering statement. This document shall not constitute an offer to sell or the solicitation of an offer to buy, nor shall there be any sale of these securities in any state or jurisdiction in which such offer, solicitation or sale would be unlawful prior to registration or qualification under the securities laws of any such state or jurisdiction.

An indication of interest involves no obligation or commitment of any kind. Any person interested in investing in any offering of Stacks Tokens should review our disclosures and the publicly filed offering statement and the final offering circular that is part of that offering statement here. Blockstack is not registered, licensed or supervised as a broker dealer or investment adviser by the SEC, the Financial Industry Regulatory Authority (FINRA) or any other financial regulatory authority or licensed to provide any financial advice or services.

This document contains forward-looking statements that are based on our beliefs and assumptions and on information currently available to us. In some cases, you can identify forward-looking statements by the following words: "will," "expect," "would," "intend," "believe," or other comparable terminology. Forward-looking statements in this document include, but are not limited to, statements about future app mining rewards, future token supply estimates, and proposals for an adaptive mint-and-burn mechanism. These statements involve risks, uncertainties, assumptions and other factors that may cause actual results or performance to be materially different. More information on the factors, risks and uncertainties that could cause or contribute to such differences is included in our filings with the SEC, including in the "Risk Factors" and "Management's Discussion & Analysis" sections of our offering statement on Form 1-A. We cannot assure you that the forward-looking statements will prove to be accurate. These forward-looking statements speak only as of the date hereof. We disclaim any obligation to update these forward-looking statements..

Stacks Token Economics and Incentive Mechanisms

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https://blockstack.org
Whitepaper Ver 2.0.6

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Abstract

Blockstack is a decentralized computing network that provides a full-stack alternative to traditional cloud computing for building secure, private applications. At the foundation of our network is the Stacks blockchain, which is designed to scale decentralized applications, and incentivize developers to build high-quality applications on the network. Stacks tokens are consumed as "fuel" to register digital assets on the network and to publish/execute smart contracts, among other functions on the network. This paper presents an overview of the previous distributions of Stacks tokens, the economic details of our App Mining mechanism that incentivizes developers to build high-quality applications on the Blockstack network, and our proposed new adaptive mint and burn mechanism for future token supply. We also summarize the findings of economic audits of our initial 2017 design. The genesis block of the Stacks blockchain went live in November 2018, and as of the third quarter of 2019, there are more than 250 decentralized applications built on the network.

1 Introduction

In the last decades, we have seen the general client/server architecture for internet applications evolve into cloud computing, where more computation and data storage happens at the cloud side. This increased dependence on remote cloud providers has led to data breaches [1], loss of privacy [2], and a general mistrust of large tech companies [3]. Blockstack is a full-stack alternative to cloud computing where users are in control by default and applications store data with the user. As of the third quarter of 2019, there are more than 250 such decentralized applications built on Blockstack, including decentralized social networks, word processors, messengers, document signing tools, and web publishing applications.

The Blockstack network removes central points of failure and trust from the traditional internet and provides a decentralized alternative to cloud computing where users

own their data. We encourage the readers to read the Blockstack whitepaper [4] for details on how the Blockstack decentralized network is designed, uses blockchains as a simple base layer, and can give comparable performance to centralized cloud systems.

The Stacks tokens are used as "fuel" to register digital assets (such as usernames, software licenses, webpages, or other digital goods) and to publish/execute smart contracts on the network. Stacks tokens associate a cost with network operations; otherwise, spammers can register junk data on the decentralized network for free (given that there are no centralized gatekeepers on the Blockstack network). Stacks tokens also provide incentives for miners to operate mining nodes, process transactions, execute smart contracts, and write new data to the Stacks blockchain. In addition to providing incentives to miners, Stacks tokens are used to incentivize developers to build high-quality applications with our App Mining program which distributes Stacks tokens to top-ranked apps on the network (see Section 3).

In this paper, we present the economic distribution of the Stacks token (Section 2), describe an adaptive mint and burn mechanism for the future supply of Stacks tokens (Section 4), and describe the token allocation and plans for App Mining (Section 3). Readers should see the Blockstack technical whitepaper [4] for details on how the design of Blockstack optimizes for security and scalability, and how there are over 250 decentralized apps built on the network. Readers should review the qualified offering circular [5, 6] Blockstack PBC has filed with the SEC for full details on Blockstack's Regulation A offering, and further information about the Stacks token as well as Blockstack PBC and its affiliates.

2 Economic Distribution

The initial block of the Stacks blockchain, called the Genesis Block, introduced 1.32 billion tokens when the network went live in November 2018 [7]. Of the 1.32 billion tokens of the Genesis Block, a total of 866,827,880 Stacks tokens were allocated to previous purchasers with the launch of the Genesis Block, while 453,172,120 remained unallocated. The allocated tokens correspond to tokens sold or distributed as part of various previously-completed token sales or distributions that took place in late 2017 and early 2018 as outlined in Subsection 2.2 below. The remainder of the Genesis Block was allocated and distributed in conjunction with the hard fork of the network that distributed the tokens sold or allocated as part of various sales and distributions that took place in 2019, as described in Subsection 2.1.

2.1 2019 Token Sales and Distributions

During 2019, Blockstack PBC offered Stacks tokens for sale through two offerings. One offering pursuant to Regulation A ("Reg A") of the Securities Act of 1933 and one pursuant to Regulation S ("Reg S") of the Securities Act of 1933. The distribution of those token offerings were part of a hard fork of the network that distributed the previously-

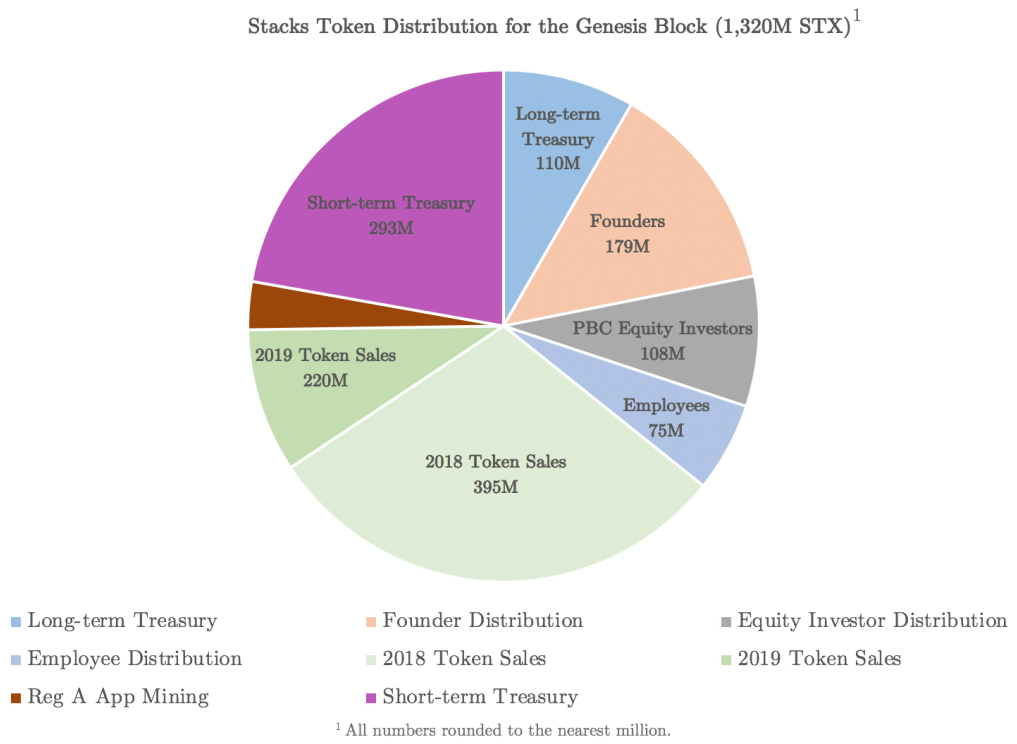


Figure 1: *Stacks Token Distribution for the Genesis Block.*

unallocated tokens of the Genesis Block, which hard fork took place in October 2019. Figure 1 shows a distribution of the Genesis Block tokens after the October 2019 hard fork.

The Reg A token offering sold 74,976,266 Stacks tokens as part of the "Cash Offering" (as described in our qualified offering circular filed with the SEC [6], which readers should review for details on the offering). In addition, as part of the Reg A offering 40 million Stacks tokens were were allocated as part of our "App Mining program" to both application developers who create well-reviewed applications and the reviewers of those applications (the "Reg A App Mining Program").

Concurrently with the Reg A offering, Blockstack PBC sold 30,560,000 Stacks tokens to non-U.S. persons in a private placement exempt from the registration requirements of the Securities Act under Reg S (the "2019 Reg S Sales").

In addition to the sales above, during 2019 Blockstack PBC entered into various agreements with non-U.S. partners and services providers under which Blockstack PBC agreed to distribute a total of 14,519,888 Stacks tokens to these partners and service providers in compliance with Regulation S (the "2019 Partner Payments").

Collectively, the Reg A Cash Offering, the 2019 Reg S Sales and the 2019 Partner Payments are referred to as the "2019 Token Sales." Distribution of the tokens sold as part of the 2019 Token Sales as well as the tokens allocated for the Reg A App Mining

Long-term Treasury	110,000,000
Founder Distribution	178,642,000
Equity Investor Distribution	108,493,373
Employee Distribution	74,509,321
2018 Token Sales	395,183,186
2019 Token Sales	120,056,154
Reg A App Mining	40,000,000
Short-term Treasury	293,115,966
Total Genesis Block	**1,320,000,000**

Table 1: *Breakdown of the Genesis Block Tokens.*

Program took place as part of a hard fork of the network in October 2019.

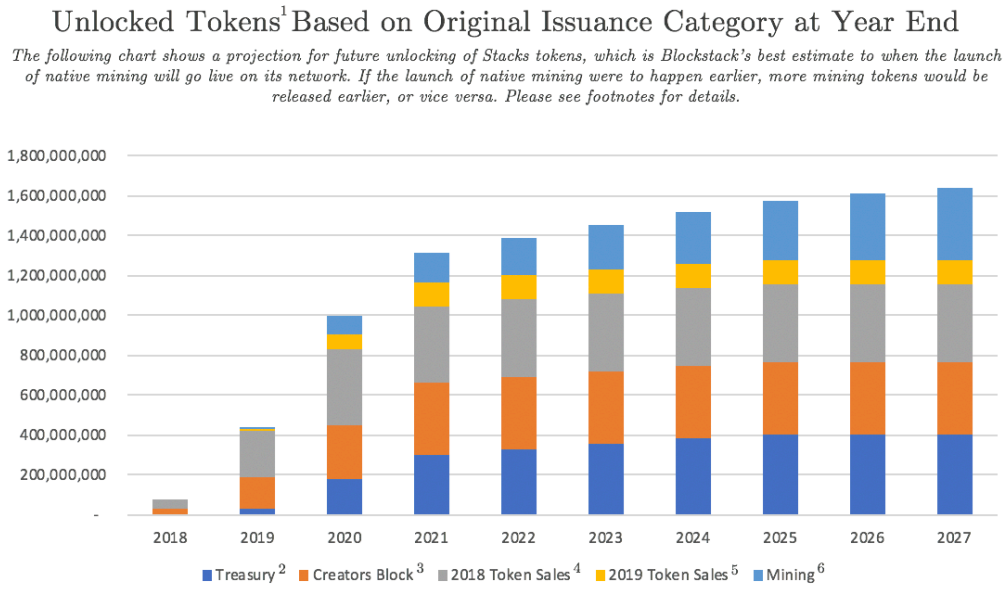
2.2 2018 Token Sales and Distributions

Prior to the 2019 token sales and distributions, Blockstack Token LLC had sold tokens in private offerings. Between November of 2017 and February of 2018, we sold the rights to 682,318,559 Stacks tokens through the following sales: 178,642,000 tokens were sold to the founders of Blockstack PBC ("Founder Distribution"); 108,493,373 tokens were sold to other stockholders of Blockstack PBC ("Equity Investor Distribution"); 218,737,294 tokens were sold via sale of equity interests in Blockstack Token Fund AI, L.P. and Blockstack Token Fund QP, L.P. (the "LP Fund Sale"); and 176,445,892 Stacks tokens were sold pursuant to simple agreements for future tokens ("SAFT Sale" and together with the LP Fund Sale, the "2018 Token Sales").

Further, in two sales 36,300,000 Stacks tokens and 38,209,321 Stacks tokens were sold to Blockstack Employee LLC, an affiliate of Blockstack PBC, for the purpose of making bonus or compensation awards to employees and contractors of Blockstack PBC in compliance with Rule 701 under the Securities Act (collectively, the "Employee Distribution"). 62,330,849 of these Stacks tokens are the subject of outstanding awards granted to our employees and contractors from September 30, 2017 through May 2019 (other than Ryan Shea and Muneeb Ali), and 12,178,472 tokens are reserved for potential future bonus or compensation awards to employees and contractors. Blockstack Employee LLC has been dissolved as an entity, and the tokens that were subject to outstanding awards are being distributed to employees and contractors, with the remainder returning to Blockstack Token LLC.

Delivery of all of the tokens sold in the sales described above was made in November 2018, upon the launch of the Genesis Block of the Stacks blockchain.

Table 1 gives a breakdown of the distribution of Genesis Block tokens. In addition to the token sales described above, the Genesis Block allocated 110,000,000 tokens to a long-term treasury controlled by Blockstack PBC (the "Long-term Treasury"). Approximately 293,115,966 million tokens from the Genesis Block remained unallocated following the 2019 token sales and distributions, and were distributed to a wallet con-



[1] Unlocked, for the purposes of this chart, means that the relevant token is no longer subject to both a time lock and a transfer lock.
[2] The "Treasury" includes the Short-term Treasury and Long-term Treasury.
[3] The "Creators Block" includes the Stacks tokens sold or distributed in the Founder Distribution, the Equity Investor Distribution, and the Employee Distribution.
[4] The "2018 Token Sales" category represents the 2018 Token Sales.
[5] The "2019 Token Sales" category represents the 2019 Token Sales.
[6] The "Mining" category assumes native mining will go live in March 2020; this category is also inclusive of the Reg A App Mining Tokens.

Figure 2: *Stacks Token Unlocking over Coming Years.*

trolled by Blockstack PBC, which, in its discretion, may sell or distribute these tokens in the future (the "Short-term Treasury").

2.3 Stacks Token Unlocking

Sales of Stacks tokens are subject to two potential types of locks on use and transfer: a "transfer lock" and a "time lock." Transfer locks are implemented where the tokens sold are considered sales of "restricted securities" under the Securities Act of 1933. Tokens subject to transfer locks are non-transferable on the Blockstack network until a one-year holding period following their sale has lapsed. A token can be burned on the network while subject to a transfer lock (provided it is not subject to a time lock), but otherwise is non-transferable. Separately, tokens on the Blockstack network can be subject to a time lock, a general restriction that prevents a Stacks token from being used for any purpose on the Blockstack network, such that the Stacks token cannot be burned or transferred. Time locks operate such that Stacks tokens unlock in equal increments each time a pre-set number of blocks is processed on the blockchain.

Most Stacks tokens on the network are subject to either an approximately two-year

or an approximately three-year time lock from the date such tokens are distributed (either from the date of the Genesis Block or from the date of the hard fork that distributes the token, if distributed after the launch of the Genesis Block). In the case of an approximately two-year time lock, 1/24th of the tokens are unlocked at the time of distribution, and 1/24th unlock on an approximately monthly basis then onward. In the case of an approximately three-year time lock, 1/36th of the tokens are unlocked at the time of distribution, and 1/36th unlock on an approximately monthly basis then onward. In both of these cases, the monthly time-frame is approximate because it is in fact measured in blocks and can take longer or shorter than a month, depending on the timing of completed blocks.

All of the Stacks tokens that have been sold or distributed, except those that have been sold through our Reg A offering or distributed through the Reg A App Mining Program, have been subject to a transfer lock. However, only the tokens sold or distributed under Reg S as part of the 2019 Token Sales and certain tokens sold or distributed as part of the Employee Distribution remain subject to a transfer lock, while the one-year transfer lock period has expired for all other tokens sold or distributed (though these tokens remain subject to time locks).

Tokens sold or distributed as part of the Founder Distribution, the Equity Investor Distribution, and the Employee Distribution are all subject to an approximately three-year time lock from the date of the Genesis Block. Tokens sold as part of the 2018 Token Sales are subject to an approximately two-year time lock from the date of the Genesis Block, except for 50,000,000 of those tokens, which are subject to an approximately four-year time lock. Tokens sold as part of the 2019 Token Sales are subject to an approximately two-year time lock from the date of the hard fork that distributed those tokens in October 2019. Lastly, the Long-term Treasury begins to unlock approximately three years after the launch of the Genesis Block and unlocks over a period of approximately four years thereafter and the Short-term Treasury unlocks from the date of the October 2019 hardfork over a period of approximately two years. Again, all of these time-frames are approximate because they are measured in blocks, which can vary in length of time, and are not measured in calendar days. See Figure 2 for an overview of token unlocking projections.

Of the 1.32 billion token Genesis Block, 802,374,713 of these tokens, corresponding to those sold as part of the Founder Distribution, Equity Investor Distribution, 2018 Token Sales and 2019 Token Sales, are as discussed above subject to time locks. We estimate that approximately 39% of these tokens will be released from their time lock by the end of October 2019, approximately 79% of these tokens will be released from their time lock by the end of October 2020, approximately 99% of these tokens will be released from their time lock by the end of October 2021, and all of them will be released from their time lock by the end of October 2022. Of the 62,330,849 Stacks tokens sold or distributed as part of the Employee Distribution and allocated to outstanding employee awards, upon the dissolution of Employee LLC in June 2019, only 5,534,869 were subject to neither time lock nor transfer lock, with the remainder being released from transfer

lock, time lock and contractual vesting restrictions on an incremental basis from then until the end of October 2022. In addition, of the 40,000,000 Stacks tokens allocated for the Reg A App Mining Program, 746,439 of those tokens were distributed as part of the October 2019 hard fork directly to application developers and application reviewers who had earned those tokens, with the remainder distributed to wallets controlled by Blockstack PBC for distribution to application developers and application reviewers who earn those tokens through the Reg A App Mining Program following the hard fork. The tokens as part of the Reg A App Mining Program are unlocked as held by Blockstack PBC and upon distribution to application developers and application reviewers.

415,294,438 Stacks tokens are held by Blockstack PBC or its subsidiaries (equal to the Long-term Treasury, the Short-term Treasury, and the unallocated Employee Distribution tokens). In addition to the time locks discussed above (which restricts the full unlocking of these tokens until, we estimate, October 2025), these tokens would become restricted securities under Rule 144 upon transfer to any other party outside of a public offering (these numbers may fluctuate if any employee terminates their employment, which would result in any unvested tokens held by that employee, which may be restricted, being returned to an affiliate of Blockstack PBC). Restricted securities may be sold in the public market only if the offer and sale is registered or if the offer and sale qualifies for an exemption from registration, including under Rule 144 promulgated under the Securities Act. Affiliates of Blockstack PBC (founders, Union Square Ventures, and executive officers), have additional restrictions on the sale of Stacks tokens (see Section "What Stacks tokens are eligible for future sale?" of the offering circular for details [6]).

3 App Mining

App Mining is the incentive mechanism for developers to build high-quality applications on Blockstack. The Reg A App Mining Program, a preliminary version of the App Mining program, has commenced issuing awards in Bitcoin and Stacks tokens to developers of well-reviewed applications on the Blockstack network and reviewers of those applications. Participating application developers are selected for awards by a panel of reviewers, each application reviewer initially selected by Blockstack PBC (which may take recommendations from other entities in making these selections). Blockstack plans to further decentralize the operations of the App Mining program in the future and potentially allow token holders to select app reviewers, amongst other things.

For the Reg A App Mining Program, application developers receive rewards out of a reward pool of Stacks tokens, starting at $100,000 in the first month of the program, and the amount of the pool that each application developer receives depends upon a percentage called the "reward share," which starts at 3%. Awards are calculated, first, by creating a relative rank for each participating application based on aggregated scores received from each app reviewer that will be aggregated into a total score. The

highest-ranked application receive a percentage of the total reward pool equal to the reward share. Each successive app receives a percentage equal to the reward share of the amount remaining in the pool after all higher-ranked applications have received their rewards (for example, if the highest-ranked app received a reward share of 3% from a rewards pool of $100,000, the highest-ranked app would receive $3,000. The second-highest ranked app would then receive a reward share of 3% from a rewards pool of $97,000, or $2,910).

Both the reward pool and reward share change over the course of the Reg A App Mining Program, with the rewards pool ultimately increasing to $1,000,000 monthly at a rewards share of 3%.

App reviewers have and will be relevant technology companies who have also proven the ability to develop or identify high-quality applications. App reviewers participate in a curation process by selecting eligible applications and assigning a normalized score to be aggregated into a final app ranking for rewards [8]. The app reviewers may also receive a percentage of the Stacks tokens distributed under the Reg A App Mining Program. Through the Reg A offering, $1,110,000 worth of Stacks tokens are reserved for distribution to app reviewers.

4 Future Token Supply

There is no pre-set limit on the number of Stacks tokens that will be released over time. The 1.32 billion Stacks tokens created in the Genesis Block will be the only tokens available on the network when native mining starts on the Stacks blockchain. The supply of Stacks tokens can decrease due to the burning of tokens to register digital assets or other burning functionality. Once mining starts, new Stacks tokens will be released using an adaptive mint and burn mechanism. The initial deployment of the Stacks blockchain, which occurred with the launch of the Genesis Block in November 2018, uses the mining mechanisms employed by the Bitcoin blockchain and no new Stacks tokens are introduced to the Stacks blockchain as a result of the Bitcoin blockchain mining mechanisms. When we release the second version of the Stacks blockchain, which will introduce native mining (which we call Tunable Proofs mining) release of new Stacks tokens will take place with each block. We expect this to occur in early 2020. See the Blockstack technical whitepaper v2.0 for details [4].

Starting in February 2019, we conducted a token economics study and audit with an independent economic consulting firm, Prysm Group [9], along with reviews from individual domain experts. The purpose of our economic audit and review was to determine an appropriate number of tokens to release according to our mining mechanisms and research any potential enhancements to our initial pre-set schedule of release of tokens. In the aggregate, based on the updated design that was the result of our work, we currently anticipate that the total number of tokens in circulation in the year 2050 will be no more than approximately 2.048 billion, subject to reduction due to the burning of tokens on the network, and assuming that native mining begins in 2020. An adaptive mint and

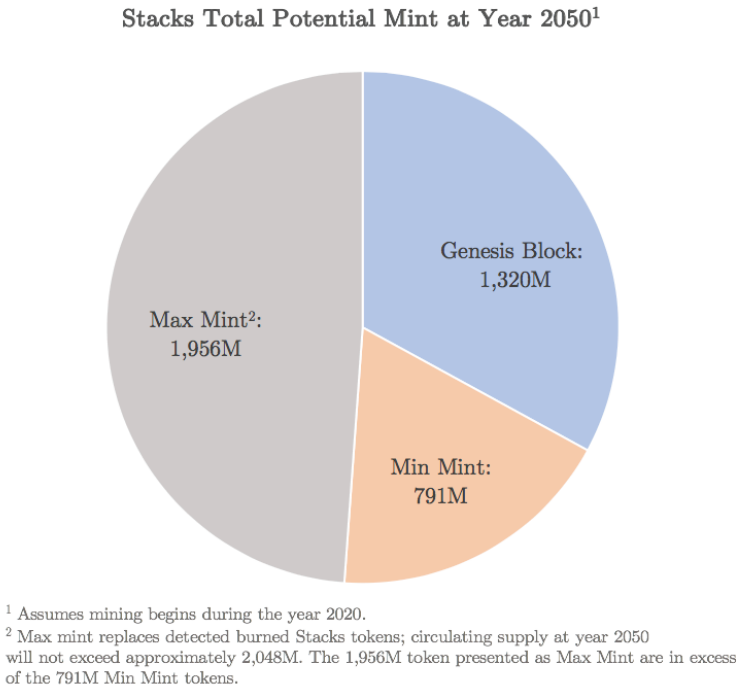


Figure 3: *Stacks Future Mint (Year 2050).*

burn mechanism (described below) determines this circulating supply which replaces the previous pre-set release schedule. The 2017 pre-set release schedule proposed to release tokens following a timeline where there would be approximately 4.072 billion tokens after ten years of introduction of mining. The 2017 pre-set schedule proposed to reduce new tokens minted every year until the issuance drops to approximately 2% of the then-current volume of Stacks Tokens after year 13 of the introduction of mining. Our token economics audit and study found the 2017 pre-set schedule to release an excessive amount of tokens, especially given that the tokens were issued regardless of network growth. The adaptive mint and burn mechanism adjusts the supply of the future tokens and makes the minting of tokens adaptive to network growth.

4.1 Adaptive Mint and Burn

Our adaptive mint and burn mechanism is designed to allow for a dynamic element to the minting of Stacks tokens as part of the mining reward for each block. The mechanism looks at Stacks tokens recently burned as a proxy for network activity and growth. The idea is to release a minimum number of Stacks tokens per block during times of low network activity and increase the number of minted tokens per block if users are burning more tokens (i.e., when there is high network activity). We believe

this system is superior to a system that simply releases a pre-set number of tokens per block, which was the design of our previous model. In particular, among other benefits, this system potentially allows for an increased reward to miners at the time of increased interest and activity from miners (which we expect to correlate with times of increased token burning and hence activity)—this system essentially creates capacity for increased miner participation. Also, we expect that this design potentially allows for increased predictability into future circulating supply of Stacks tokens, given that, despite unpredictable burning behavior, there is an adaptive element to the release of future tokens that counteracts burning by design.

The planned implementation of the adaptive mint and burn mechanism operates by releasing a number of Stacks tokens per block that is greater than or equal to a minimum number of tokens (which we call *min mint*) and less than or equal to a maximum number of tokens (which we call *max mint*). For each block, the adaptive mechanism algorithmically adjusts the number of tokens released per block, depending on the number of tokens that have been recently burned on the network (though never dropping below *min mint* and never exceeding *max mint*). In order to determine the number of tokens recently burned, the adaptive mechanism takes into consideration the average number of Stacks tokens burned per block over a period of time ending at some point before the block for which the reward is being determined (we can call this the "evaluation window"). Based on this average number of Stacks tokens burned per block during the evaluation window (call this number D), the number of Stacks tokens released for the relevant block is then adjusted. If D is greater than or equal to zero and $min\ mint + D$ is less than $max\ mint$, then the number of tokens released for that block is equal to $min\ mint + D$. And if $min\ mint + D$ is greater than or equal to $max\ mint$, then $max\ mint$ is the number of tokens released for that block.

To restate the above more precisely, let us call all blocks on the blockchain B_n, where n is a natural number. And call R_n the number of tokens rewarded as the block reward for any given block B_n.

At each block, B_n the system will evaluate the average number of tokens burned during the evaluation window, which will be the blocks spanning the xth preceding block through the yth preceding block (where $x > y$), or the blocks numbered B_{n-x} through block B_{n-y}. Let us call d_n the number of tokens burned during a particular block B_n, and call the average number of tokens burned per block over the entire evaluation window D_n. Therefore:

$$D_n = \frac{1}{x - y + 1} \sum_{i=n-x}^{n-y} d_i \tag{1}$$

Thus the block reward, R_n, for each block B_n, will be as follows:

$$R_n = \begin{cases} min\ mint_n + D_n, & if\ (min\ mint_n + D_n < max\ mint_n), \\ max\ mint_n, & if\ (min\ mint_n + D_n \geq max\ mint_n). \end{cases} \tag{2}$$

Where $min\ mint_n$ and $max\ mint_n$ are $min\ mint$ and $max\ mint$ at block B_n, respectively. In our implementation, the adaptive mint and burn mechanism can only detect a subset of burns on the network (developers might burn in ways that the mechanism is unable to trace) and so the mechanism only takes into account that subset which it can detect. The adaptive mint and burn mechanism is expected to go live with the release of the second version of the Stacks blockchain, simultaneously with the start of native mining on the Blockstack network.

4.2 Token Mint and Net Inflation

We expect that once native mining goes live, approximately 4383 blocks will be processed per month, or approximately 52,596 blocks will be processed per year. With our design for the adaptive mint and burn mechanism, *min mint* is equal to 500 tokens per block for the first approximately five years (or 262,980 blocks), 400 tokens per block for the next approximately five years, and then 300 tokens per block for all years thereafter. During these times, a minimum of 500 tokens, 400 tokens, and 300 tokens, respectively, will be released per block regardless of Stacks tokens burned on the network. The number of minted tokens can increase from *min mint* depending on the number of Stacks recently burned during the evaluation window as described in the section above. The maximum number of minted tokens per block, or *max mint*, is currently planned to be 3000 for the first approximately five years of mining (or 262,980 blocks), 2000 for the next approximately seven years, and 1000 for all years thereafter. The future potential mint of new Stacks tokens through approximately year 2050 is shown in Figure 3. Other than mining rewards, Stacks miners are also incentivized by transaction fees and "fuel" payments for registering/executing smart contracts.

In addition to the block rewards for miners, 12,000,000 Stacks tokens per year are allocated to the App Mining program for the first ten years (this is separate from the Reg A App Mining Program). Further, 25,000,000 and 15,000,000 Stacks tokens are allocated to potential user incentives in the first and second year, respectively, after mining starts. The resulting expected total token mint per year and net inflation are shown in Figure 4. The net inflation shown reflects maximum circulating supply (which is the same for both min mint and max mint scenarios).

4.3 Open Research Questions

While we have finalized certain design elements of our new adaptive mint and burn mechanism, including, for instance, the number of tokens for the *min mint* awards and the resulting max supply (including, for instance, at year 2050), there are certain aspects of our planned design for which we're doing further research. There are currently two open questions that we're actively researching:

	Min Mint	Max Mint	Max Total	Net Inflation
Genesis Block	N/A	N/A	1,320,000,000	N/A
Year 01	63,298,000	194,788,000	1,383,298,000	4.80%
Year 02	53,298,000	184,788,000	1,436,596,000	3.85%
Year 03	38,298,000	169,788,000	1,474,894,000	2.67%
Year 04	38,298,000	169,788,000	1,513,192,000	2.60%
Year 05	38,298,000	169,788,000	1,551,490,000	2.53%
Year 06	33,038,400	117,192,000	1,584,528,400	2.13%
Year 07	33,038,400	117,192,000	1,617,566,800	2.09%
Year 08	33,038,400	117,192,000	1,650,605,200	2.04%
Year 09	33,038,400	117,192,000	1,683,643,600	2.00%
Year 10	33,038,400	117,192,000	1,716,682,000	1.96%
Year 11	15,778,800	105,192,000	1,732,460,800	0.92%
Year 12	15,778,800	105,192,000	1,748,239,600	0.91%
Year 13	15,778,800	52,596,000	1,764,018,400	0.90%
Year 14	15,778,800	52,596,000	1,779,797,200	0.89%
Year 15	15,778,800	52,596,000	1,795,576,000	0.89%
Year 16	15,778,800	52,596,000	1,811,354,800	0.88%
Year 17	15,778,800	52,596,000	1,827,133,600	0.87%
Year 18	15,778,800	52,596,000	1,842,912,400	0.86%
Year 19	15,778,800	52,596,000	1,858,691,200	0.86%
Year 20	15,778,800	52,596,000	1,874,470,000	0.85%
Year 21	15,778,800	52,596,000	1,890,248,800	0.84%
Year 22	15,778,800	52,596,000	1,906,027,600	0.83%
Year 23	15,778,800	52,596,000	1,921,806,400	0.83%
Year 24	15,778,800	52,596,000	1,937,585,200	0.82%
Year 25	15,778,800	52,596,000	1,953,364,000	0.81%
Year 26	15,778,800	52,596,000	1,969,142,800	0.81%
Year 27	15,778,800	52,596,000	1,984,921,600	0.80%
Year 28	15,778,800	52,596,000	2,000,700,400	0.79%
Year 29	15,778,800	52,596,000	2,016,479,200	0.79%
Year 30	15,778,800	52,596,000	2,032,258,000	0.78%
Year 31	15,778,800	52,596,000	2,048,036,800	0.78%

Figure 4: *Adaptive Mint/Burn and Net Inflation (which reflects max circulating supply).*

4.3.1 Max Mint

In the design of our adaptive mint and burn mechanism, we have considered increasing *max mint*, making *max mint* more adaptive, or even eliminating the concept of *max mint* entirely. In the last case, this would mean that R_n, as outlined in equation (2) above, would simply be:

$$R_n = min\ mint_n + D_n \tag{3}$$

An argument in favor of eliminating *max mint* would be that we do not want to allow for a shrinking eco-system and circulating supply of Stacks tokens, which would result in the event that actual burn was in excess of *max mint* (and might likely correlate with a time of high network activity). One counter-argument here might be that retaining *max mint* avoids the possibility of excessive or extreme number of tokens being released to the network at any given time. Since *max mint* only replaces Stacks tokens burned, it cannot increase the circulating supply from the maximum supply shown in Figure 4.

4.3.2 Evaluation Window

We're actively researching the pros and cons of longer/shorter evaluation windows. The current default values are $x = 15340$ and $y = 2191$. This would result in an evaluation window that is approximately three months long, that ends approximately 15 days prior to the block that is using it to determine its reward. These numbers ultimately determine the length of time of the evaluation window (which is equal to $x - y$ blocks), and how much time elapses between the end of the evaluation window and B_n, the block for which the reward is being determined (this is equal to y blocks).

The evaluation window should be sufficiently large such that individual blocks would not have an outsized effect on D_n, and thus it would be expensive for an individual to manipulate D_n. However, we also believe that the evaluation window shouldn't be too large; otherwise, long-stale burning behavior would affect the block reward. Ultimately, we believe that appropriate values of x and y will optimize system responsiveness while minimizing the potential for individual manipulation. Similarly, we believe that the end of the evaluation window should allow for latency that would discourage manipulative behavior, but be sufficiently close in time to ensure the adaptive minting is responsive to circumstances that continue to be relevant.

We're working with relevant domain experts on these two open questions and collected feedback from the broader Blockstack community on the general design of the adaptive mint and burn mechanism and these specific open questions [10]. We plan to update this token economics whitepaper as we address the respective open questions.

5 Conclusion

The traditional internet is a 40-year-old technology that was originally meant to be a decentralized network but ended up with centralized points of control and failure. Traditional internet applications rely on remote servers and storage and there has been an increasing concern for user privacy and data security in recent years. Blockstack is a decentralized computing network that provides a full-stack alternative to traditional cloud computing where users can own their data. As of the third quarter of 2019, more than 250 applications are built on the network. This paper presents the economic distribution of the Stacks token, allocation and plans for our App Mining program that incentivizes developers to build high-quality applications, and a new adaptive mint and burn mechanism for future token supply. We also summarized results of recent economic audits; these economic audits informed the design of our adaptive mint and burn mechanism.

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